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Original Article

THE POLYPROPYLENE MESH IN THE LAPAROSCOPIC REPAIR OF LARGE HIATAL HERNIAS: TECHNICAL ASPECTS

tela de polipropileno no reparo laparoscópico de grandes hérnias hiatais: aspectos técnicos

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ABSTRACT – ***Background*** - The minimally invasive surgery has gained rapidly important role in the treatment of gastroesophageal reflux disease. However, the best method to treat large paraesophageal hernias (type Ⅲ and Ⅳ) is still under discussion. The use of prosthetics for enhancing the crural repair has been proposed by several authors in order to reduce the high relapse rates found in these patients. ***Aim*** - To demonstrate the technique and surgical results in using an idealized polypropylene mesh for the strengthening of the cruroraphy in large hiatal hernias. ***Methods*** - Was applied the polypropylene mesh to reinforce the hiatal closure in large hernias - types Ⅱ to Ⅳ in Hill's classification - with a primary or recurrent hiatal defect greater than 5 cm, in a series of 70 patients. The prosthesis was done cutting a polypropylene mesh in a U-shape, adapted to the dimensions found in the intraoperative field and coating the inner edge (which will have direct contact with the esophagus) with a silicon catheter. This was achieved by removing a small longitudinal segment of the catheter and then inserting the edge of the cut mesh, fixing with running nylon 5-0 suture. ***Results*** - From 1999 to 2012, this technique was used in 70 patients. There were 52 females and 18 males, aged 32-83 years (mean 63 years). In 48 (68.6%) patients, paraesophageal hernia was primary and in 22 (31.4%), it was relapse after antireflux surgery. The only case of death in this series (1.4%) occurred on 22nd postoperative day in one patient (74 y) that had a laceration of the sutures on the fundoplication, causing gastropleural fistula and death. There was no relationship with the use of the prosthesis. A follow-up of six months or more was achieved in 60 patients (85.7%), ranging from six to 146 months (mean 49 months). All patients have at least one follow-up endoscopy or esophageal contrast examination, and a clinical interview. In this follow-up period, no cases of complications related to the prosthesis (stenosis or erosion) were observed. ***Conclusion***- The use of this model of polypropylene mesh is safe if the technical aspects of its placement are followed carefully.

HEADINGS – Hiatal hernia. Surgical mesh. Fundoplication.

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RESUMO - ***Racional***: A cirurgia minimamente invasiva ganhou rapidamente papel fundamental no tratamento da doença do refluxo gastroesofágico. Entretanto, o melhor método para as grandes hérnias paraesofágicas (tipos Ⅲ e Ⅳ) ainda está em discussão. O uso de próteses para reforço da hiatoplastia tem sido proposto por diversos autores, no intuito de diminuir as altas taxas de recidivas encontradas nesses pacientes. Riscos de estenose e erosão da prótese são as complicações mais preocupantes quando se pensa em aplicar uma prótese no hiato esofágico. ***Objetivo*** - Demonstrar a técnica cirúrgica e resultados do uso de um modelo de tela idealizado no serviço dos autores para reforçar a hiatoplastia em grandes hérnias de hiato. ***Métodos*** - Uma prótese de polipropileno foi aplicada para reforço da hiatoplastia em pacientes com grandes hérnias de hiato (Tipos Ⅱ a Ⅳ de Hill). A prótese era cortada em forma de U, com sutura de cateter de silicone na borda côncava que ficaria em contato com o esôfago. Após sua fixação sobre a hiatoplastia, toda prótese era recoberta por gordura do omento maior, impedindo contato com o fundo gástrico ou fundoplicatura. ***Resultados*** - De 1999 a 2012, esta técnica foi utilizada em 70 pacientes. Eram 52 do sexo feminino e 18 do sexo masculino, com idades variando de 32 a 83 anos (média de 63 anos). Em 48 (68,6%) pacientes, tratava-se de hérnias primárias e em 22 (31,4%) era recidivada após operação antirrefluxo. O único óbito ocorreu por sepse (1,4%) no 22o dia pós-operatório em caso com laceração da sutura da fundoplicatura causando fístula gastropleural. Não houve relação direta com o uso da prótese. Seguimento de seis meses ou mais foi obtido em 60 pacientes (85,7%), variando de seis a 146 meses (média de 49 meses). Todos os pacientes foram submetidos à entrevista clínica e pelo menos uma endoscopia e/ou radiografia contrastada no período de acompanhamento. Durante o seguimento, não foram observadas complicações (estenose ou erosão) relacionadas com a prótese. ***Conclusão*** - O uso do modelo de prótese de polipropileno descrito é seguro, desde que observados os aspectos técnicos de sua implantação.

DESCRITORES - Hérnia hiatal. Telas Cirúrgicas. Fundoplicatura

INTRODUCTION

Laparoscopy is accepted, for almost two decades, as the gold standard in surgical treatment of gastroesophageal reflux disease (GERD), for the low morbidity and mortality rates and excellent results. However, the literature demonstrates an incidence of hernia recurrence following hiatoplasty not negligible.

The correction of large paraesophageal hernias, primary or after anti-reflux surgery is one of the issues still under discussion by the experts.

Initially, laparoscopy was not indicated in these cases, because higher rates of relapse were observed, when compared to patients treated by open surgery[5,10,11,13,14,18,19].

Hashemi et al.[10], did a retrospective study comparing the long-term outcome of 54 patients with large paraesophageal hernias operated by open techniques (thoracotomy or laparotomy) and laparoscopy. Clinical evaluation, with mean follow-up of 24 months showed good and excellent results in similar values in both groups. However, radiological examinations of 41 patients with mean follow-up of 27 months showed hernia recurrence in nine of 21 patients operated by laparoscopy (42%) and three in 20 patients operated by open techniques (15%).

Table 1 shows the recurrence rates of some authors who performed contrast study after laparoscopic repair of large paraesophageal hernias.

TABLE 1 – Recurrence rates after laparoscopic surgery for large paraesophageal hernias

Author	Postoperative study	Recurrence
Hashemi (2000)[5]	69%	32%
Wu (1999)[10]	78%	42%
Khaitan (2002)[11]	65%	32%
Jobe (2002)[13]	60%	40%
Mattar (2002)[14]	26%	33%
Diaz (2003)[18]	81%	20%
Targarona (2004)[19]	92%	23%

Although there is a greater chance of hernia recurrence, the minimally invasive method gained space by reducing the morbidity and mortality of the procedure, since most patients with large hernias are over 65 years old and have multiple comorbidities.

Athanasakis et al.[2] first demonstrated that the laparoscopic treatment of these patients have less morbidity and shorter hospitalization and convalescence period than the open approach. Schauer et al.[17], also compared the postoperative evolution in the short term in patients with paraesophageal hernias operated laparoscopically or via open surgery and, despite longer operative time in laparoscopy, other factors such as blood loss, stay in the intensive care unit, postoperative ileus, hospitalization and morbidity were lower in the laparoscopic surgery group.

But how to reduce recurrences?

Technical details such as complete removal of the hernial sac, perform a total fundoplication, fixing the stomach to the abdominal wall or diaphragmatic crura are recommended by several authors to achieve better results, but without scientific evidence.

One topic, however, has gained increasing focus: the use of prosthetic reinforcement of the crural repair[1,3,4,7,8,9,15,20]. Several types of series, prospective non-randomized studies and prospective randomized studies were published or are underway, trying to answer: 1) does it decrease recurrence?; 2) is it safe in the short term?; 3) is it safe for long term?; 4) what is the ideal material of the prosthesis?; 5) what is the ideal shape of the prosthesis?; 6) onlay or "tension free" positioning?; 7) use routinely or in special situations?

The idea of applying a mesh to reinforce hiatal closure follows the principle of applying these materials in ventral and inguinal hernias, where it is known to reduce recurrence rates.

A comprehensive review of the literature regarding the use of prosthesis in the hiatus (1,368 patients) was published recently by Johnson et al.[12]. One must consider the fact that the authors combine studies with different types of prostheses (PTFE, polypropylene, organic), shapes (rectangular, circular, "U-shaped"), application techniques (onlay or interposed between the pillars) and indication (routine in simple hernias and large paraesophageal hernias). The compiled results show that, in patients with simple hernias (n=987), 1.5% recurrence was observed in the group with the prosthesis (n=411) and 9.5% in the group without prosthesis (n=576). In the group of patients with paraesophageal hernias (n=381) recurrence was 2.6% for the prosthesis (n=228) and 15% in the group without prosthesis (n=153).

However, the diaphragmatic hiatus is not covered by peritoneum, is traversed by the esophagus, which has no serosa layer and is in constant mobilization with respiration. This region is also in direct contact with the gastric fundus. For these reasons, there is a potential risk of shrinkage, leading to dysphagia and erosion or penetration of prostheses placed in this area.

Furthermore, the characteristics of an ideal prosthesis for this region should be: rapid tissue integration, minimal shrinkage, lack of adherence to hollow viscera and good transparency for secure attachment.

Many materials are being used and there is no consensus about which is the best. The most common, low cost and easy handling is polypropylene. Allows good visualization and rapid integration, increasing the tensile strength of the hiatus.

Having this information in mind, the authors tried to develop a method of using a mesh to reinforce the crural raphy in some special situations (large paraesophageal hernias, primary and recurrent), in order to reduce the chances of relapse while avoiding

the dreaded complications of stenosis and erosion in hollow viscera.

The present study aimed to demonstrate the technique idealized in surgical service of the authors using a polypropylene mesh in strengthening the crurorraphy in large hiatal hernias.

METHODS

Was applied the polypropylene mesh to reinforce the hiatal closure in large hernias - types II to IV in Hill's classification (Figure 1), with a hiatal defect greater than 5cm - primary or recurrent 1.

o Type I -	Sliding hernia - the most common type, the esophagogastric junction migrates through the gap in the cephalad direction.
o Type II -	Paraesophageal hernia - only migrates the gastric fundus, the esophagogastric junction remains in intra-abdominal position.
o Type III -	Combination of types I and II.
o Type IV -	Involves the migration of other structures and organs such as omentum or transverse colon

FIGURE 1 – Hill's Classification[10]

Intraoperative technique

The camera was put halfway between the xiphoid and umbilicus off the midline for better visualization of the mediastinum. As dissection begins, whenever possible, complete removal of the hernia sac is realized.

After complete dissection of the hiatus and esophagus, with reduction of the hernia components back to the abdominal cavity, the hiatal closure is done with nonabsorbable interrupted stiches.

The prosthesis is done cutting a polypropylene mesh in a "U"-shape, adapted to the dimensions found in the intraoperative field (usually 7 cm lateral and 8 cm anteroposteriorly) and coating the inner edge (which will have direct contact with the esophagus) with a silicon catheter. This is achieved by removing a small longitudinal segment of the catheter and then inserting the edge of the cut mesh, fixing with running, nylon 5-0 nonabsorbable suture (Figure 2).

The prosthesis is, then, applied as a reinforcement over the sutures and fixed with endostapler. We must be always careful when applying the staples near the anatomical region corresponding to the passage of the aorta into the abdomen, and the contact region of the diaphragm to the pericardium (Figure 3).

Once fixed, the prosthesis is covered with the great omentum, which is passed behind the esophagus, interposing between the fundoplication (which at this point is already made) and the surface of polypropylene. The fat tissue is fixed to the prosthesis with the same endoscopic stapler (Figure 4).

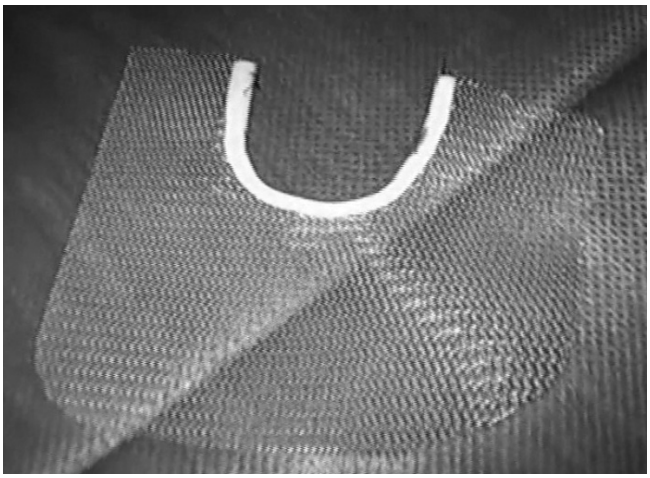

FIGURE 2 - Polypropylene prothesis with silicon catheter, as designed by Nilton Cesar Aranha

FIGURE 3 – Prothesis on hiatoplasty

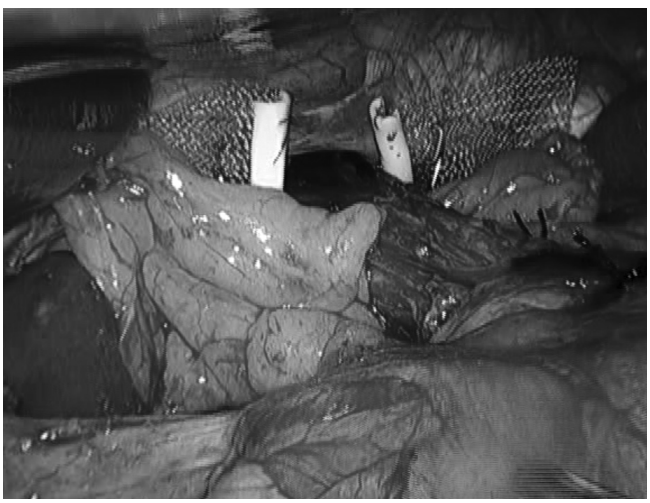

FIGURE 4 – Fat tissue from the great omentum covering the prosthesis, before fixation with additional staples

RESULTS

From 1999 to 2012, this technique was used in 70 patients. There were 52 females and 18 males, aged 32-83 years (mean 63 years). Importantly, the average age of patients with primary hernias was 67 years, stressing that they are hernias that appear in older patients. In 48 (68.6%) patients, paraesophageal hernia was primary and in 22 (31.4%).

The only case of death in this series (1.4%) occurred on 22nd postoperative day. On the 10th postoperative day, the patient (74 y) had a laceration of the points of the fundoplication, which caused a gastropleural fistula, culminating with respiratory insufficiency and death, despite adequate chest drainage and control of the fistula. There was no relationship with the use of the prosthesis.

A follow-up of six months or more was achieved in 60 patients (85.7%), ranging from six to 146 months (mean 49 months). All patients have at least one follow-up endoscopy or esophageal contrast examination, and a clinical interview (Figure 5).

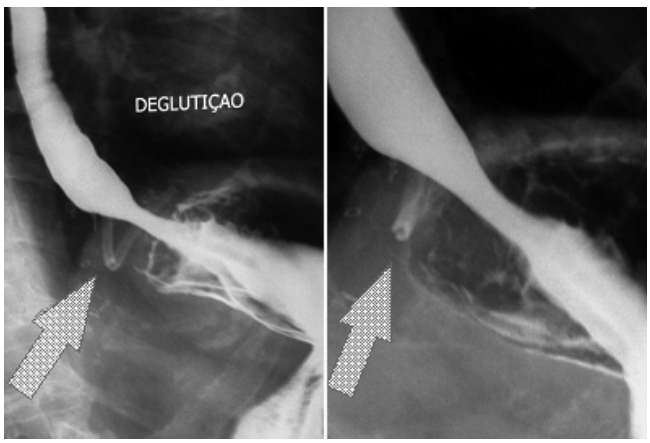

FIGURE 5 – Radiographies showing the proper positioning of the mesh and the esophagogastric junction

There were found nine recurrences in these 60 pacients (15%), eight of them smaller than 3 cm. Six occurred after redo and three in primary surgeries, that means 8,3% of recurrence in primary surgery and 27.3% after a reoperation for paraesophageal hernia.

In this follow-up period, no cases of complications related to the prosthesis (stenosis or erosion) were observed.

DISCUSSION

The recurrence rates are high in the laparoscopic treatment of large paraesophageal hernias or hiatal hernia recurrence, but can be reduced with the use of prostheses. The application of mesh-reinforced hiatal closure has resulted in a significant reduction in recurrence rates and has been an option adopted by the surgeons. However, the main complications described includes: fibrosis, esophageal stenosis and intraluminal erosion, which causes dysphagia.

Between 1995 and 1997, Champion measured, prospectivamente, the diameter of the hiatus in 476 antireflux surgeries, with simple suture of the crura with nonabsorbable stiches, and found 0.9% of recurrence when the diameter was less than 4,5cm and 10.6% when the diameter was larger or equal to 5,0cm (p <0,000001)[8].

Frantzides and Carlson[14] started a prospective and randomized trial to evaluate the rates of hernia recurrence with or without the use of mesh. They included in this study 72 patients with intraoperative measurement of the hiatus larger than 8cm. After a mean follow up of 3.3 years, they observed 22% (8/36) of recurrence in group with simple suture and zero in the 36 patients in whom the sutures were covered with a circular PTFE prosthesis. They didn't had any cases of migration or erosion of the prosthesis[7].

Antoniou et al.[1] published an extensive review of the literature of authors who employ prosthesis for reinforcement of closing the diaphragmatic hiatus in recent years. Were revised twenty-three articles totalizing 1,446 patients. The majority of the authors (52%) utilized the polypropylene mesh placed posterior to the esophagus, performing a "tension-free" hiatoplasty. The recurrence rates employing the polypropylene meshes varied from 0 to 22,7% (median 1.9%) and the dysphagia rates varied from 0 to 21,7% (median 3.9%). The authors emphasizes that the intraluminal erosion of the esophagus is the most serious complication of the prostheses, and the incidence reported was low (0-0.49%). However, the handling is frequently complex, requiring esophagectomy or total gastrectomy. In the present review, only one such complication was related (0.07%), but the number may be considerably higher.

The solution initially proposed by Nilton Cesar Aranha (surgeon of our Surgical Service) was to find a safe way of strengthening the sutures, using a material with low cost and high power of tissue integration.

Our choice of material - polypropylene - is due to a number of factors: high availability, easy handling by laparoscopy, transparency (which gives security in time to fix it with staples) and price. The main disadvantage of polypropylene - potential erosion - is minimized by the measures outlined above.

A polypropylene mesh is cut in a "U"-shape, adapted to the dimensions found in the intraoperative field and coat the inner edge, which will have direct contact with the esophagus, with a silicon catheter. This is achieved by removing a small longitudinal segment of the catheter and then inserting the edge of the cut mesh (Figure 2), fixing with running, nonabsorbable suture. Thus, the esophagus can slide without friction on the mesh, minimizing the risk of migration in this area. The placement of the catheter in the mesh, besides

serving as a protection against esophageal erosion, helps to locate and determine its proper positioning in relation to the esophagogastric junction (Figure 4).

Since the esophagus is not involved circumferentially, the fear of strangulation of the gastroesophageal junction, leading to dysphagia and severe stenosis due to retraction of the prosthesis, is also diminished.

To avoid direct contact with the mesh, we interpose fat from the greater omentum between the gastric fundus and fundoplication, and fix it in place with endostapler.

The fixation of the mesh and the omental protection with endostapler is preferred by our group, since placing stiches in this area is both difficult and dangerous, as we can't longer see posterior face of the diaphragm and there is a risk of damaging lung, aorta or pericardium. This is also the reason that we prefer to use straight staplers instead of helicoidal ones, witch penetrates deeper in the diaphragm an is more likely to cause serious lesions[7].

This study was not randomized to demonstrate a difference of recurrence with or without the use of mesh, because when explained the possible rates of recurrence, the majority didn't accept to be operated without a mesh, even when pointing out the risks related to the placement of a mesh in this area.

Nevertheless, other studies have already demonstrated that the use of mesh lowers the rates of recurrence, it is the possibility of complications what we have do pay attention to[1,4,7,8,9,12].

In our series with a long follow-up period, we found no complications related to the use of a mesh, even in those patients with recurrence.

Prosthesis made of biological materials have appeared to be useful in a short period, but long term follow-up results have failed to demonstrate a difference in relation to simple suture in large hernias[15,16].

It was not found, in the reviewed literature, neither this kind of mesh design, nor the tactics of covering it with adipose tissue.

The analysis of this series in the period of follow-up described, confirms the impression from the literature that the use of prosthesis for repair of types II to IV paraesophageal hernias - primary or recurrent – can be helpful in managing this difficult situations.

CONCLUSION

The use of this model of polypropylene mesh is safe if the technical aspects of its placement are followed carefully.

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